

INVOLVEMENT OF THE NEURAL CREST IN DEVELOPMENT OF
THE AUSTRALIAN LUNGFISH
NEOCERATODUS FORSTERI (KREFFT 1870)

EXTENDED ABSTRACT

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There is considerable evidence from amphibian, avian and mammalian embryos that migratory cells of the neural crest contribute to the formation of many organs and that these cells have far-reaching effects on the structure and function of the resulting adult (le Douarin, 1982). While some of this evidence may be 'misinterpretation and erroneous observations on unsuitable material' (Goodrich, 1930: 764), some is well founded, and there is little doubt that the neural crest is important in developing embryos of higher vertebrates.

Even though the migration of neural crest cells in elasmobranch embryos was recognized by Kastchenko as early as 1888, information on the role of neural crest cells in lower vertebrates is sparse because their embryos are less amenable to experimental manipulation than those of higher vertebrates. Using extirpation experiments, Newth (1951) found that cells of the neural crest in *Lampetra planeri* form part of the dorsal root ganglia, most of the melanophores, and some of the ectomesenchyme. Evidence from xenoplastic transplants indicates that neural crest cells are also involved in skeletal structures of the head in this species (Newth, 1956). Lopashov (1944) studied the role of neural crest cells in the origin of pigment cells and visceral cartilages in teleosts.

Serial sections of neurulae of *Neoceratodus forsteri* show that migrating neural crest cells begin to enter the embryo from the neural plate as the neural folds start to develop, and that migration continues as the folds form. The overall pattern of migration is reminiscent of that in amphibian embryos. However, experiments on *Neoceratodus forsteri* indicate that cells of the neural crest can be removed from both sides of the neural plate in the head region without affecting normal development or pigment patterns. A range of developmental stages was used, from early neural plate formation at stage 17 (when the folds are barely perceptible) to stage 22 (just prior to closure of the neural tube; stages defined by Kemp, 1982). This makes it unlikely that all the crest cells had already migrated before the extirpation experiments were performed. Either the embryos of *N. forsteri* are capable of a surprising degree of regulation, or cells of the neural crest are of limited importance in development of this animal. This result is in contrast to those of similar experiments performed on amphibian and bird embryos, where removal of neural crest cells produces marked abnormalities in development of the brain or visceral skeleton (le Douarin, 1982).

The possibility that the neural crest cells of at least one lower vertebrate are dispensable, and that other cells might fulfil their functions, is significant for embryological theory. The apparent difference in the importance of the neural crest in lungfish and higher vertebrates is also significant for phylogenetic theory. Some workers, basing their argument on the Recent lungfish, consider that lungfishes are the sister group of the tetrapods (Rosen *et al.*, 1981), but others have disagreed (Campbell & Barwick, 1986; Marshall, 1986; Panchen & Smithson, 1987; Schultze & Campbell, 1986). It is also possible that the 'target tissues' of lungfish neural crest cells (if any) differ from those of Amphibia. In the urodele *Ambystoma mexicanum* part of the tooth germ is of neural crest origin (Sellman, 1955) and the oral epithelium is ectodermal (Adams, 1924), at least in part (Chibon, 1970). Using orthotopic grafts with neural crest cells labelled with tritiated thymidine, Chibon (1966) found that the tooth papillae of the urodele *Pleurodeles waltii* contained labelled cells. In lungfish the mouth epithelium is of endodermal origin (Kemp, 1977a and pers. obs.) and determination of the tissue of origin of the mesenchyme component of the tooth germs is of considerable theoretical interest (Kemp, 1977b, 1979 and 1984; Smith, 1984).

□ *Dipnoi, Neoceratodus, development, neural crest.*

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